Second Quarter 2005
Groundwater Monitoring Report

Branscomb Store
Branscomb, California
Case No. 1TMC214

Prepared for:

Harwood Products

Consulting Engineers & Geologists, Inc.
812 W. Wabash Ave.
Eureka, CA 95501-2138
707 / 44108855

May 2005
092057

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash • Eureka, CA 95501-2138 • 707-441-8855 • Fax 707-441-8877 • info@shn-eureka.com

Reference: 092057

May 25, 2005

Ms. Bonnie Rolandelli
California Regional Water Quality Control Board
North Coast Region
5550 Skylane Boulevard, Suite A
Santa Rosa, CA 95403

Subject: Second Quarter 2005 Groundwater Monitoring Report, Branscomb Store 1 Main Street, Branscomb, California; Case No. 1TMC214

Dear Ms. Rolandelli:

SHN Consulting Engineers & Geologists, Inc. (SHN), on behalf of Harwood Products, is submitting this second quarter 2005, groundwater monitoring report for the Branscomb Store, located at 1 Main Street in Branscomb, California. SHN conducted the groundwater-monitoring event on April 20, 2005.

If you have any questions, please do not hesitate to call me at 707-441-8855.

Sincerely,

SHN Consulting Engineers & Geologists, Inc.

Frans Lowman, R.G.
Project Manager

FBL/SLD:lms
Enclosure: Report
copy w/encl: Michael Patrick, Harwood Products

Reference: 092057

Second Quarter 2005
Groundwater Monitoring Report

Branscomb Store
Branscomb, California
Case No. 1TMC214

Prepared for:

Harwood Products

Prepared by:

Consulting Engineers & Geologists, Inc.
812 W. Wabash Ave.
Eureka, CA 95501-2138
707-441-8855

May 2005

QA / QC: FBL___

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List of Illustrations

Acronyms and Abbreviations

<	denotes a value that is "less than" the method detection limit
mg/L	milligram per Liter
mV	millivolts
ppm	parts per million
ug/L	micrograms per Liter
AST	Aboveground Storage Tank
ASTM	American Society of Testing and Materials
BTEX	Benzene, Toluene, Ethylbenzene, and total Xylenes
DIPE	Diisopropyl Ether
DCO_2	Dissolved Carbon Dioxide
DO	Dissolved Oxygen
EC	Electrical Conductivity
ETBE	Ethyl Tertiary-Butyl Ether
EPA	U.S. Environmental Protection Agency
FE	Iron
MCDEH	Mendocino County Division of Environmental Health
MCL	Maximum Contaminant Level
MSL	Mean Sea Level
MTBE	Methyl Tertiary-Butyl Ether
MW-#	Monitoring Well-#
NA	Not Analyzed
NR	No Reference
NO_3	nitrate
ORP	Oxidation-Reduction Potential
RWQCB	California Regional Water Quality Control Board, North Coast Region
SHN	SHN Consulting Engineers & Geologists, Inc.
SO_4	sulfate
TAME	Tertiary-Amyl Methyl Ether
TBA	Tertiary-Butyl Alcohol
TPHG	Total Petroleum Hydrocarbons as Gasoline
UST	Underground Storage Tank

1.0 Introduction

This report presents the results of groundwater monitoring for the second quarter 2005, conducted at the Branscomb Store. The site is located at 1 Main Street in the community of Branscomb, California (Figure 1). SHN Consulting Engineers & Geologists, Inc. (SHN) performed this work on April 20, 2005, on behalf of Harwood Products.

1.1 Organization

This report is presented in five sections. This section introduces the reader to the site. Section 2.0 discusses the scope of work completed at the site during the second quarter 2005, monitoring event, including groundwater sampling. Section 3.0 presents the results of the groundwater-monitoring program. Section 4.0 presents conclusions regarding the nature of the site, as well as recommendations for future site activities. Section 5.0 presents a list of references cited.

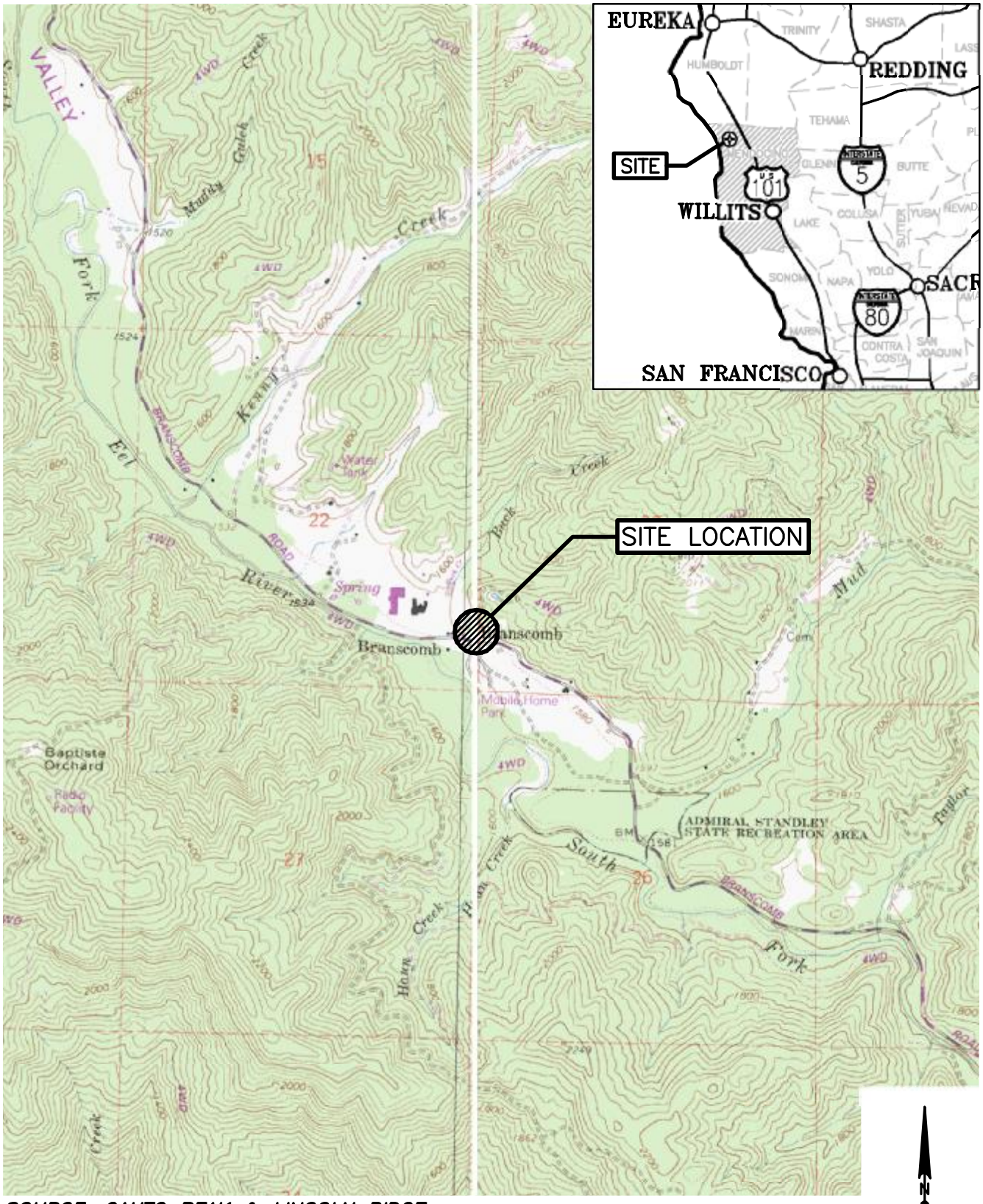
1.2 Site Background

Branscomb Store contains an active retail fuel station that operates with an Aboveground Storage Tank (AST) system. Two 1,000-gallon gasoline Underground Storage Tanks (USTs), and one 500-gallon gasoline UST, were operated at the site from the late 1950s until 1990. In October 1991, the three USTs were removed from the site. A representative from the Mendocino County Division of Environmental Health (MCDEH) was present during the tank removals, and completed an "Underground Hazardous Materials Storage Tank Abandonment Inspection Report." According to the MCDEH report, the former tanks were of single-walled steel construction, and all were noted to contain small holes that may have been attributable to corrosion. Approximately 50 cubic yards of soil were excavated during the tank removal activities. The former UST locations are shown on Figure 2.

During the UST removals, a series of soil samples was collected from the former tank locations. The soil samples were analyzed for Total Petroleum Hydrocarbons as Gasoline (TPHG); Benzene, Toluene, Ethylbenzene, and total Xylenes (BTEX); and total lead. Laboratory analyses of the soil samples that were collected revealed detectable concentrations of petroleum hydrocarbons.

SHN conducted a limited subsurface investigation at the site in April 1997. Five exploratory soil borings were installed in the area of the former USTs. Temporary well points were then installed in each boring for the collection of a groundwater sample. Information collected during this investigation indicated that groundwater at the Branscomb Store site had been impacted by petroleum hydrocarbons. The extent of petroleum hydrocarbon-impacted groundwater appeared to be limited to the immediate area around the former UST locations.

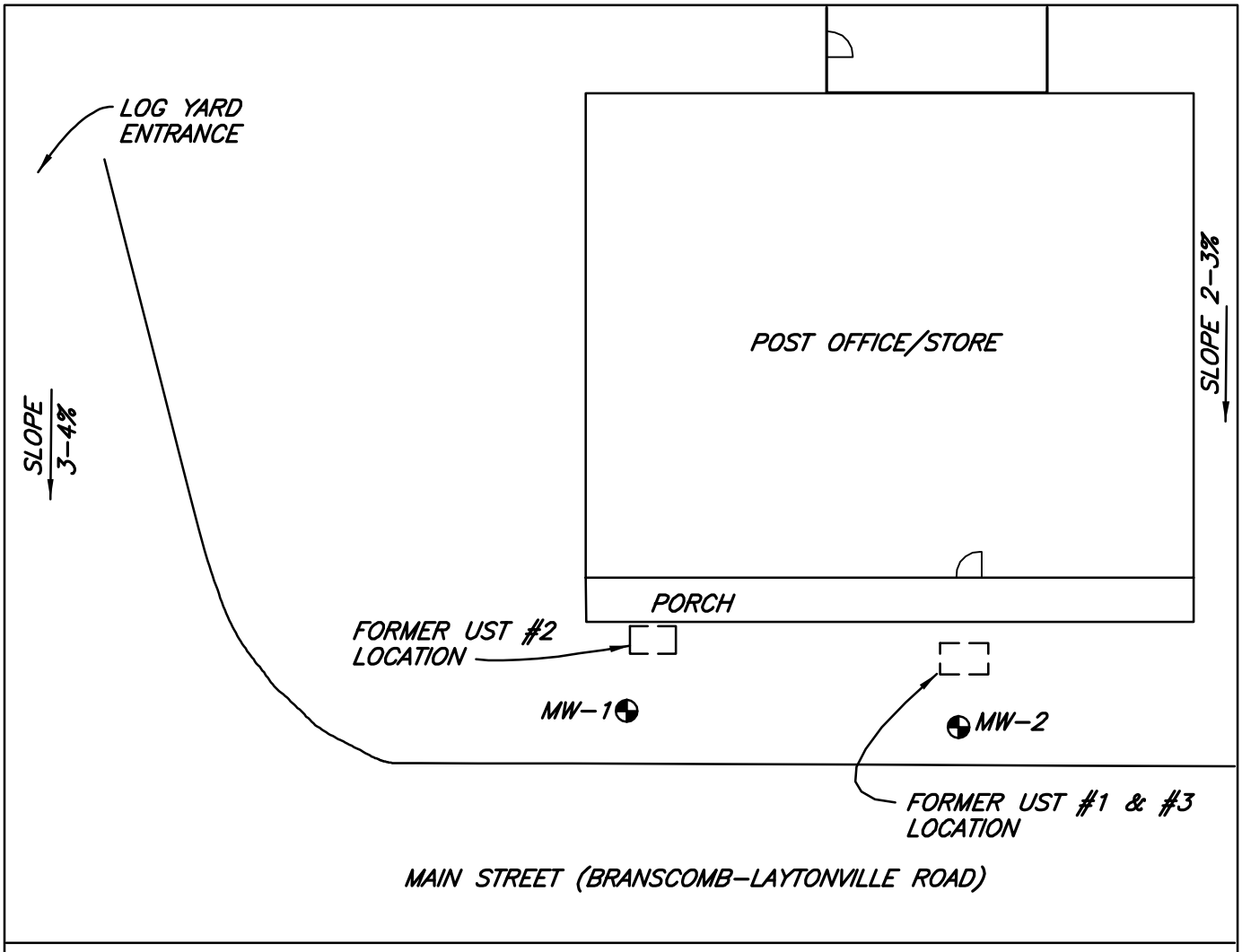
In January 2000, SHN supervised the installation of four groundwater-monitoring wells (MW-1 through MW-4) at the Branscomb Store site, as approved by the California Regional Water Quality Control Board, North Coast Region (RWQCB) on February 11, 1998 (SHN, 2000).



SOURCE: CAHTO PEAK & LINCOLN RIDGE
USGS 7.5 MINUTE
QUADRANGLE

1"=2000'±

SHN Consulting Engineers & Geologists, Inc.	Branscomb Store 1 Main Street Banscomb, California	Site Location Map SHN 092057	
	MAY 2005	092057-LOCATION	Figure 1



EXPLANATION

MW-2 ⊕ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

N

1"=20'

ALL LOCATIONS ARE APPROXIMATE

SHN Consulting Engineers & Geologists, Inc.	Branscomb Store 1 Main Street Branscomb, California		Site Plan SHN 920057
	October, 2004	920057-site	Figure 2

Quarterly monitoring was initiated at the Branscomb Store site on February 22, 2000, as required by the RWQCB. Groundwater monitoring occurred at the site for a period of one year, and was not conducted for the following three years. On August 13, 2004, quarterly groundwater monitoring was resumed at the site, and is ongoing.

In February 2005, SHN conducted a sensitive receptor survey, using a 1,000-foot search radius from the Branscomb Store site. As described at length in the February 2005 ***Work Plan For Additional Site Investigation*** (SHN, 2005), the results of the survey did not reveal any known or potential sensitive receptors within the designated search radius that may be impacted from known contaminated groundwater at the Branscomb Store site.

On February 3, 2005, SHN submitted a work plan for additional site investigation to the RWQCB, for the purpose of assessing soil and groundwater conditions downgradient of the former UST locations, as well as the area downgradient of monitoring well MW-2. The direction of groundwater flow at the site has historically been west-to-northwestward.

2.0 Field Activities

2.1 Monitoring Well Sampling

SHN conducted the second quarter 2005, groundwater-monitoring event on April 20, 2005. As part of the monitoring program, monitoring wells MW-1, MW-2, MW-3, and MW-4 were purged and sampled (Figure 2). Prior to purging, each monitoring well was measured for depth to water, and checked for the presence of floating product (none was observed). Electrical Conductivity (EC), pH, and temperature were monitored periodically during purging activities using portable instruments. All wells were also measured for Dissolved Oxygen (DO), Oxidation-Reduction Potential (ORP), and Dissolved Carbon Dioxide (DCO_2).

A groundwater sample was then collected from each well using a disposable polyethylene bailer. The water samples were immediately placed in an ice-filled cooler, and submitted to the laboratory for analysis under appropriate chain-of-custody documentation. Field notes and water sampling data sheets from the April 20, 2005, monitoring event are included in Appendix A.

2.2 Laboratory Analysis

Each groundwater sample was analyzed for:

- TPHG and BTEX, in general accordance with U.S. Environmental Protection Agency (EPA) Method No. 8260B.
- Fuel oxygenates Methyl Tertiary-Butyl Ether (MTBE), Tertiary-Butyl Alcohol (TBA), Tertiary-Amyl Methyl Ether (TAME), Diisopropyl Ether (DIPE), and Ethyl Tertiary-Butyl Ether (ETBE), in general accordance with EPA Method No. 8260B.

North Coast Laboratories Ltd., a state-certified analytical laboratory located in Arcata, California, performed the sample analyses.

2.3 Equipment Decontamination Procedures

All monitoring and sampling equipment was cleaned prior to being transported to the Branscomb Store site. All smaller equipment was initially washed in a water solution containing Liquinox® cleaner, followed by a distilled water rinse, then by a second distilled water rinse.

2.4 Investigation-Derived Waste Management

All rinse water used for decontaminating field-sampling equipment, and all well purge water was temporarily stored on site in five-gallon plastic buckets. The water was then transported to SHN's 1,000-gallon purge water storage tank located at 812 West Wabash Avenue in Eureka, California. Approximately 32 gallons of decontamination and purge water from the April 20, 2005, sampling event will be tested and discharged, under permit, to the City of Eureka municipal sewer system. A copy of the discharge receipt will be included in the next quarterly monitoring report. Appendix A contains the discharge receipt for the 31 gallons of water that were generated during the January 19, 2005, monitoring event.

3.0 Groundwater Monitoring Results

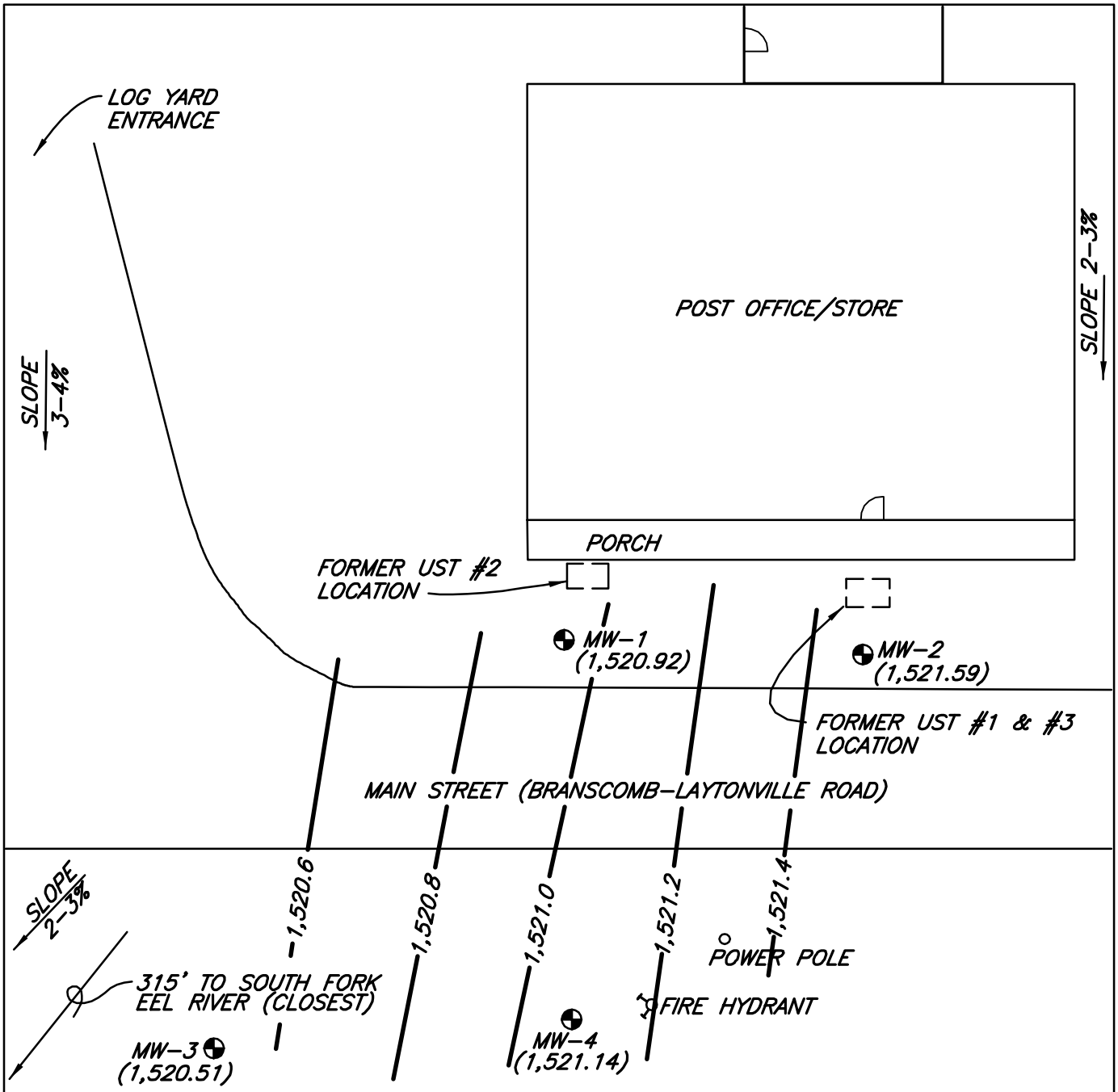
3.1 Hydrogeology

SHN measured depth-to-groundwater in the existing monitoring wells during the second quarter 2005 monitoring event (Table 1). On April 20, 2005, the direction of groundwater flow beneath the Branscomb Store site was to the west, with an estimated gradient of 0.010. A groundwater contour map for the April 20, 2005, monitoring event is presented as Figure 3. Historic groundwater elevation data are presented in Appendix B, Table B-1.

Table 1
Groundwater Elevations, April 20, 2005
Branscomb Store, California

Sample Location	Top of Casing Elevation (feet MSL)[1]	Depth to Groundwater[2] (feet)	Groundwater Elevation (feet MSL)
MW-1	1,529.31	8.39	1,520.92
MW-2	1,529.67	8.08	1,521.59
MW-3	1,526.61	6.10	1,520.51
MW-4	1,528.32	7.18	1,521.14

1. MSL: Mean Sea Level
2. Below top of casing



EXPLANATION

MW-2 ⊕ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

(1,521.14) GROUNDWATER ELEVATION IN FEET ABOVE MSL

—1,520.8— CONTOUR OF EQUAL GROUNDWATER ELEVATION

HYDRAULIC GRADIENT=0.010 FT/FT

N

1"=20'

ALL LOCATIONS ARE APPROXIMATE

SHN Consulting Engineers & Geologists, Inc.	Branscomb Store 1 Main Street Branscomb, California		Groundwater Contours, April 20, 2005 SHN 920057
	MAY 2005	920057-GWC-APR-05	Figure 3

3.2 Groundwater Analytical Results

The laboratory analytical results for the groundwater samples collected during the second quarter 2005, monitoring event are summarized in Table 2. TPHG was detected in the groundwater sample collected from monitoring well MW-2, at a concentration of 460 micrograms per Liter (ug/L). None of the other groundwater samples that were collected contained detectable concentrations of TPHG, BTEX, or fuel oxygenates. The concentrations of TPHG, Benzene, and MTBE in the existing groundwater monitoring wells on April 20, 2005 are shown on Figure 4. The complete laboratory analytical report and corresponding chain-of-custody documentation are included in Appendix C. Historic groundwater analytical data are presented in Appendix B, Table B-2.

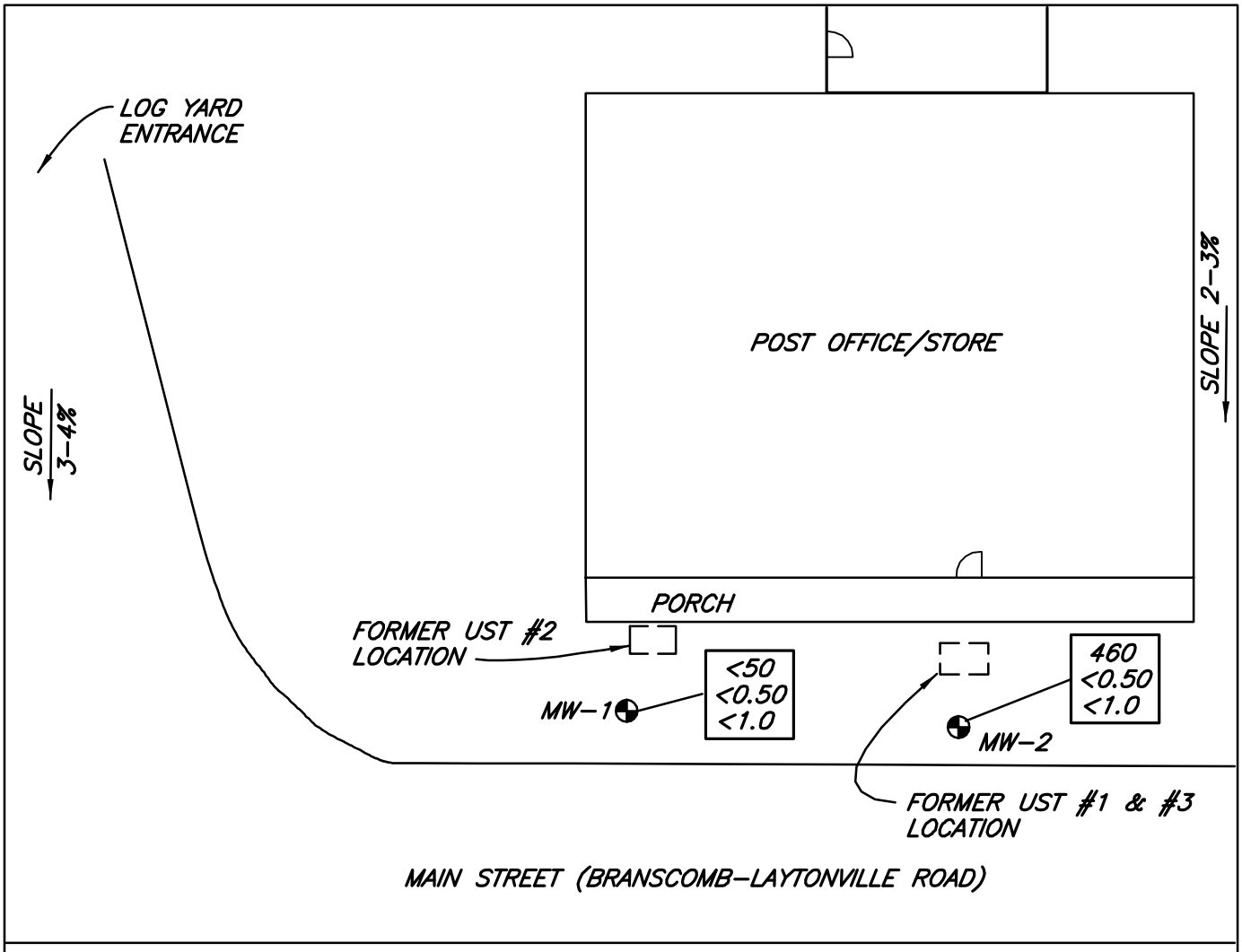
Table 2
Groundwater Analytical Results, April 20, 2005
Branscomb Store, Branscomb, California
(in ug/L)[1]

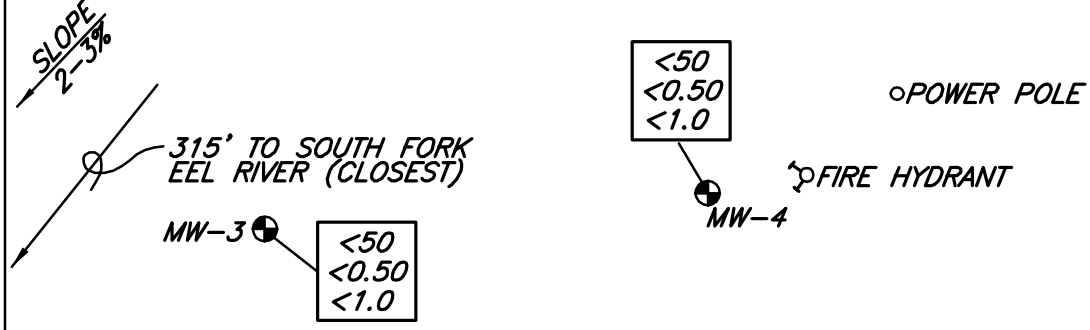
Sample Location	TPHG[2]	B[3]	T[3]	E[3]	X[3]	MTBE[4]	TBA[4]	DIPE[4]	ETBE[4]	TAME[4]
MW-1	<50[5]	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
MW-2	460[6]	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
MW-3	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
MW-4	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0

1. ug/L: micrograms per Liter
2. TPHG: Total Petroleum Hydrocarbons as Gasoline, analyzed in general accordance with EPA Method No. 8260B.
3. Benzene (B), Toluene (T), Ethylbenzene (E), and total Xylenes (X), analyzed in general accordance with EPA Method No. 8260B.
4. Fuel Oxygenates: Methyl Tertiary-Butyl Ether (MTBE), Tertiary-Butyl Alcohol (TBA), Diisopropyl Ether (DIPE), Ethyl Tertiary-Butyl Ether (ETBE), and Tertiary-Amyl Methyl Ether (TAME), analyzed in general accordance with EPA Method No. 8260B.
5. <: denotes a value that is "less than" the method detection limit.
6. Sample does not present a peak pattern consistent with that of gasoline. The reported result represents the amount of material in the gasoline range. The peaks elute towards the end of the gasoline range.

3.3 Natural Attenuation Parameters

DO, DCO_2, and ORP were measured prior to sampling in all four groundwater monitoring wells on April 20, 2005, and are summarized in Table 3. DO concentrations ranged from 0.63 parts per million (ppm) in well MW-2, to 2.07 ppm in well MW-3. These DO concentrations appear to be sufficient to support biodegradation. DCO_2 concentrations ranged from 30 ppm in wells MW-3 and MW-4, to 120 ppm in well MW-2, and indicate that biodegradation is occurring at the site. ORP measurements ranged from -57 millivolts (mV) in well MW-2, to 218 mV in well MW-3, indicating that mildly oxidizing conditions exist downgradient of monitoring well MW-2. Historic DO, DCO_2, and ORP measurements are included in Appendix B, Table B-3.





EXPLANATION

MW-2 GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

460 TPHG
<0.50 BENZENE
<1.0 MTBE
CONCENTRATIONS IN ug/L

N

1"=20'

ALL LOCATIONS ARE APPROXIMATE

Consulting Engineers & Geologists, Inc.	Branscomb Store 1 Main Street Branscomb, California	Summary of Groundwater Analytical Results, April 20, 2005 SHN 920057	
	MAY 2005	920057-SUM-GAR-APR-2005	Figure 4

Table 3 DO, DCO_2, and ORP Measurement Results, April 20, 2005 Branscomb Store, Branscomb, California			
Sample Location	DO[1] (ppm)[2]	DCO_2[3] (ppm)	ORP[4] (mV)[5]
MW-1	0.76	40	202
MW-2	0.63	120	-57
MW-3	2.07	30	218
MW-4	1.01	30	216

1. DO: Dissolved Oxygen, field measured using portable instrumentation.
2. ppm: parts per million
3. DCO_2: Dissolved Carbon Dioxide, field measured using a field test kit.
4. ORP: Oxidation-Reduction Potential measured using portable instrumentation.
5. mV: millivolts

When evaluating intrinsic bioremediation, it is useful to compare groundwater parameters collected within the contaminant plume to groundwater parameters collected from outside of the contaminant plume. Groundwater analytical results indicate that a petroleum hydrocarbon plume is present in the area monitored by well MW-2. It is assumed that groundwater collected from wells MW-3 and MW-4 is representative of background conditions. For this evaluation, wells MW-2 (source area well) and MW-3 (downgradient well) were used. As shown in Table 4, all three biodegradation indicators follow the trend that would be expected when biodegradation is occurring.

Table 4 Intrinsic Bioremediation Indicator Comparison, April 20, 2005 Branscomb Store, Branscomb, California					
Groundwater Bioremediation Parameter	Units	Expected Trend for Source Well Related to Background	Source Well MW-2	Down-gradient Well MW-1	Consistent with Trend
TPH Concentration	ug/L	Decreases	460	<50	Yes
Dissolved Oxygen	ppm[1]	Increases	0.63	0.76	Yes
Dissolved Carbon Dioxide	ppm	Decreases	120	40	Yes
Oxidation-Reduction Potential	mV[2]	Increases	-57	202	Yes

1. ppm: parts per million
2. mV: millivolts

4.0 Discussion and Recommendations

During the second quarter 2005, monitoring event, the groundwater sample collected from monitoring well MW-2 contained TPHG at a concentration of 460 ug/L. No detectable concentrations of BTEX components, or fuel oxygenates were present in the groundwater sample collected from this well. The groundwater samples collected from wells MW-1, MW-3, and MW-4 during this event did not contain any detectable concentrations of TPHG, BTEX, or fuel oxygenates.

Quarterly monitoring will continue at the Branscomb Store site, as required by the RWQCB. The next quarterly sampling event is scheduled for July 2005. The groundwater samples will be analyzed for TPHG, BTEX, and fuel oxygenates, using EPA Method No. 8260B. Additionally, SHN recommends that groundwater samples collected from site wells MW-1, MW-2, and MW-3 be analyzed for dissolved iron (Fe), alkalinity, nitrate (NO_3), and sulfate (SO_4). The results from these additional analyses will provide supplementary information regarding the biodegradation of petroleum hydrocarbons in groundwater at the site.

5.0 References Cited

SHN Consulting Engineers & Geologists, Inc. (April 2000). "Well Installation Report of Findings, Harwood Products Branscomb Store, Branscomb, CA." Eureka: SHN.

---. (2005). "Work Plan for Additional Site Investigation, Branscomb Store, Branscomb, CA." Eureka:SHN

Appendix A

Field Notes

CONSULTING ENGINEERS & GEOLOGISTS, INC.
480 Hemsted Drive • Redding, CA 96002• Tel: 530.221.5424 • FAX: 530.221.0135 •E-mail: shninfo@shn-redding.com
812 W. Wabash • Eureka, CA 95501 • Tel: 707.441.8855 • FAX: 707.441.8877 •E-mail: shninfo@shn-engr.com

DAILY FIELD REPORT

JOB NO 092057
Page 1 of 8

PROJECT NAME: Branscomb Store	CLIENT/OWNER: Harwood Products	DAILY FIELD REPORT SEQUENCE NO: 1	
GENERAL LOCATION OF WORK: Branscomb, CA	OWNER/CLIENT REPRESENTATIVE: Michael Patrick	DATE: 4-20-05	DAY OF WEEK: Wednesday
TYPE OF WORK: Quarterly Sampling	WEATHER: Clear	PROJECT ENGINEER/ SUPERVISOR: Frans Lawman	
SOURCE & DESCRIPTION OF FILL MATERIAL	KEY PERSONS CONTACTED	TECHNICIAN: David R. Paine	

DESCRIBE EQUIPMENT USED FOR HAULING, SPREADING, WATERING, CONDITIONING, & COMPACTING

0848	arrived at site, located all 4 wells. mw-3 had to be dug up with a backhoe, Removed lids and caps on all 4 wells. mw-1 and mw-2 had water in flush mount, bailed out.
0941	I started taking water levels deconing the sounder after each well by scrubbing it with liquinex then rinsing it with DI water.
0954	I started taking DO Readings.
1032	I started purging mw-4 with a disposable bailer, purge water was caught in a graduated 5 gal. bucket, well went dry.
1103	I started purging mw-3 with a disposable bailer, purge water was caught in a graduated 5 gal. bucket.
1150	I sampled mw-4, secured well with cap and lid.
1157	I started purging mw-1 with a disposable bailer, purge water was caught in a graduated 5 gal. bucket.
1220	I sampled mw-3, secured well with cap and lid.
1230	I started purging mw-2 with a disposable bailer, purge water was caught in a graduated 5 gal. bucket.
1255	I sampled mw-1, secured well with cap and lid.
1310	I sampled mw-2, secured well with cap and lid.
1326	OFF SITE
Note	All decon water and purge water was caught in 5 gal. buckets with lids then transported to SHN's 1,000 gal. PWST located at 812 W. Wabash Avenue Eureka, CA 32 gallons total.

COPY GIVEN TO:

REPORTED BY: David R. Paine

K:\Forms\Field Forms\Daily Field Report.doc

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EQUIPMENT CALIBRATION SHEET

Name: David R. Pains

Project Name: Branscomb Store

Reference No.: 092057

Date: 4-20-05

Equipment: ☒ pH & EC ☐ PID ☐ $GTCO_2$ ☐ GTLEL
☐ Turbidity ☒ Other Dissolved Oxygen meter YSI95

Description of Calibration Procedure and Results:

pH eEc meter is calibrated using a 2 buffer method with 7.01 and 4.01, the Ec (conductivity) is set at 1413 µS.

DO meter is self calibrating with the Altimeter set at 15.

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Groundwater Elevations

Job No.: 092057 Name: David R. Paint

Client: HARWOOD PRODUCTS Date: 4-20-05

Location: BRANSCOMB CA Weather: Clear

Sample Location	Time of Reading	Top of Casing Elevation (feet)	Depth To Water (feet)	Water Surface Elevation (feet)
MW-1	0946	1529.31	8.39	1520.92
MW-2	0948	1529.67	8.08	1521.59
MW-3	0943	1526.61	6.10	1520.51
MW-4	0941	1528.32	7.18	1521.14

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Water Sampling Data Sheet

Project Name:	Brainscomb Store	Date/Time:	4-20-05
Project No.:	092057	Sampler Name:	David R. Paine
Location:	Brainscomb, CA	Sample Type:	Ground water
Well #:	MW-1	Weather	Clear
Hydrocarbon Thickness/Depth (feet):	NA	Key Needed:	YES Dolphin

Total Well Depth (feet)	-	Initial Depth to Water (feet)	=	Height of Water Column (feet)	x	0.163 gal/ft (2-inch well) / 0.653 gal/ft (4-inch well)	=	1 Casing Volume (gal)
14.95	-	8.39	=	6.56	x	0.163	=	1.07

Time	DO (ppm)	CO_2 (ppm)	ORP (mV)	EC (uS/cm)	Temp (°F)	pH	Water Removed (gal)	Comments
1012	0.76						0 gal.	
1157	↓	40	202				0.75 gal.	
1204	↓			148	59.4°	5.88	1.25 gal.	
1208	No Flow			148	58.2°	5.88	2.25 gal.	
211	Hand cdl			148	58°	5.90	3.25 gal.	
1255	Sample Time							

Purge Method: Hand Bail

Total Volume Removed: 3.25 (gal)

Laboratory Information

Sample ID	# & Type of Containers	Preservative / Type	Laboratory	Analyses
MW-1	3-40ml VOA's	YES HCL	NCL	TPHG/BTEX/MTBE

Well Condition: Good

Remarks:

Discharged to 8.40 at sampling Time

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Water Sampling Data Sheet

Project Name:	Branscomb Store	Date/Time:	4-20-05
Project No.:	092057	Sampler Name:	David R. Paine
Location:	Branscomb, CA	Sample Type:	Ground water
Well #:	MW-2	Weather	Clear
Hydrocarbon Thickness/Depth (feet):	NA	Key Needed:	YES Dolphin

Total Well Depth (feet)	-	Initial Depth to Water (feet)	=	Height of Water Column (feet)	x	0.163 gal/ft (2-inch well) / 0.653 gal/ft (4-inch well)	=	1 Casing Volume (gal)
14.60	-	8.08	=	6.52	x	0.163	=	1.06

Time	DO (ppm)	CO_2 (ppm)	ORP (mV)	EC (uS/cm)	Temp (°F)	pH	Water Removed (gal)	Comments
1019	0.63						0 gal.	
1230	↓	120	-57				0.25 gal.	
1236	↓			420	60.6°	6.43	1.25 gal.	
1240	No Flow			361	59.9°	6.39	2.25 gal.	
1244	Hand bail			363	59.5°	6.40	3.25 gal.	
1247				362	59.6°	6.43	4.25 gal.	
1310	Sample Time							

Purge Method: Hand Bail — Total Volume Removed: 4.25 (gal)

Laboratory Information

Sample ID	# & Type of Containers	Preservative / Type	Laboratory	Analyses
MW-2	3-40ml VOA's	YES HCL	NCL	TPHG/BTEX/MTBE

Well Condition: Good

Remarks:

Discharged to 8:55 at sampling Time

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Water Sampling Data Sheet

Project Name:	Branscomb Store	Date/Time:	4-20-05
Project No.:	092057	Sampler Name:	David R. Paine
Location:	Branscomb, CA	Sample Type:	Ground water
Well #:	MW-3	Weather	Clear
Hydrocarbon Thickness/Depth (feet):	NA	Key Needed:	YES Dolphin

Total Well Depth (feet)	-	Initial Depth to Water (feet)	=	Height of Water Column (feet)	x	0.163 gal/ft (2-inch well) / 0.653 gal/ft (4-inch well)	=	1 Casing Volume (gal)
20.10	-	6.10	=	14.00	x	0.163	=	2.28

Time	DO (ppm)	CO_2 (ppm)	ORP (mV)	EC (uS/cm)	Temp (°F)	pH	Water Removed (gal)	Comments
1006	2.07						0 gal.	
1103		30	218				0.25 gal.	
1116	↓			430	58°	7.26	2.50 gal.	
1122	No Flow			432	56.2°	7.42	5 gal.	
1127	Hand bail			444	58.6°	7.48	7 gal.	
1133				447	59°	7.58	9.20 gal.	
1142				438	59.9°	7.66	11.50 gal.	Dry
1220	Sample Time							

Purge Method: Hand Bail

Total Volume Removed: 11.50 (gal)

Laboratory Information

Sample ID	# & Type of Containers	Preservative / Type	Laboratory	Analyses
MW-3	3-40ml VOA's	YES HCL	NCL	TPHG/BTEX/MTBE

Well Condition: Good

Remarks:

Discharged to 15.32 at sampling Time

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash • Eureka, CA 95501-2138 • 707/441-8855 • FAX: 707/441-8877 • shninfo@shn-engr.com

Water Sampling Data Sheet

Project Name:	Brannscomb Store	Date/Time:	4·20·05
Project No.:	092057	Sampler Name:	David R. Paine
Location:	Brannscomb, CA	Sample Type:	Ground water
Well #:	MW-4	Weather	Clear
Hydrocarbon Thickness/Depth (feet):	NA	Key Needed:	YES Dolphin

Total Well Depth (feet)	-	Initial Depth to Water (feet)	=	Height of Water Column (feet)	x	0.163 gal/ft (2-inch well) / 0.653 gal/ft (4-inch well)	=	1 Casing Volume (gal)
19.40	-	7.18	=	12.22	x	0.163	=	1.99

Time	DO (ppm)	CO_2 (ppm)	ORP (mV)	EC (uS/cm)	Temp (°F)	pH	Water Removed (gal)	Comments
0959	1.01						0 gal.	
1032	↓	30	216				0.25 gal.	
1040	↓			451	59°	7.03	2 gal.	
1045	No Flow			482	58.2°	7.24	4 gal.	
1049	Hand bail			499	58.6°	7.43	6 gal.	
1054				493	58.8°	7.60	8 gal.	
1110				479	60.3°	7.71	10 gal.	Dry
1150	Sample Time							

Purge Method: Hand Bail

Total Volume Removed: 10.00 (gal)

Laboratory Information

Sample ID	# & Type of Containers	Preservative / Type	Laboratory	Analyses
MW-4	3-40ml VOA's	YES HCL	NCL	TPHG/BTEX/MTBE

Well Condition: Good

Remarks:

Recharged to 15.77 at sampling Time

Client Name: **BRANSCOMB STORE**

The water from your site: **1 MAIN STREET BRANSCOMB, CA**
RWQCB CASE # 1TMC214

SHN ref # **092057** Collected On: **1/19/05**

Has been tested and certified as acceptable to be discharged into the City of Eureka municipal sewer system.

Amount Discharged: **31 GALLONS**

Date Discharged: **2/28/05**

Certified by: **DAVID R. PAINE**

SHN CONSULTING ENGINEERS & GEOLOGISTS, INC.
City of Eureka Wastewater Discharge Permit #65

Appendix B

Historic Monitoring Data

Table B-1
Historic Groundwater Elevations
Branscomb Store, Branscomb, California

Sample Location	Date	Top of Casing Elevation (feet MSL)[1]	Depth to Water (feet)[2]	Groundwater Elevation (feet MSL)
MW-1	2/22/00	1,529.31	7.74	1,521.57
	5/16/00		8.66	1,520.65
	10/27/00		9.00	1,520.31
	1/2/01		8.63	1,520.68
	8/13/04		8.98	1,520.33
	11/8/04		8.73	1,520.58
	1/19/05		8.28	1,521.03
	4/20/05		8.39	1,520.92
MW-2	2/22/00	1,529.67	8.13	1,521.54
	5/16/00		8.42	1,521.25
	10/27/00		9.00	1,520.67
	1/2/01		8.52	1,521.15
	8/13/04		8.90	1,520.77
	11/8/04		8.63	1,521.04
	1/19/05		7.94	1,521.73
	4/20/05		8.08	1,521.59
MW-3	2/22/00	1,526.61	5.92	1,520.69
	5/16/00		6.34	1,520.27
	10/27/00		6.55	1,520.06
	1/2/01		6.32	1,520.29
	8/13/04		6.51	1,520.10
	11/8/04		6.34	1,520.27
	1/19/05		6.00	1,520.61
	4/20/05		6.10	1,520.51
MW-4	2/22/00	1,528.32	6.98	1,521.34
	5/16/00		7.40	1,520.92
	10/27/00		7.69	1,520.63
	1/2/01		7.43	1,520.89
	8/13/04		7.69	1,520.63
	11/8/04		7.41	1,520.91
	1/19/05		7.05	1,521.27
	4/20/05		7.18	1,521.14

1. MSL: Mean Sea Level
2. Below top of casing

Table B-2
Historic Groundwater Analytical Results
Branscomb Store, Branscomb, California
(in ug/L)[1]

Sample Location	Date	TPHG[2]	Benzene[3]	Toluene[3]	Ethyl-benzene[3]	Total Xylenes[3]	MTBE[4]	TBA[4]	DIPE[4]	ETBE[4]	TAME[4]
MW-1	2/22/00	170	<0.50[5]	<0.50	<0.50	1.1	<3.0	NA[6]	NA	NA	NA
	5/16/00	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0
	10/27/00	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0
	1/2/01	<50	<0.50	<0.50	<0.50	<0.50	<3.0	NA	NA	NA	NA
	8/13/04	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	11/8/04	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	1/19/05	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	4/20/05	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
MW-2	2/22/00	2,400	<0.50	<5.0	<4.0	<4.0	3.0	NA	NA	NA	NA
	5/16/00	1,500	<0.50	<0.50	<0.50	<0.50	2.2	<10	<1.0	<1.0	<1.0
	10/27/00	240	<0.50	<0.50	<0.50	<0.50	2.9	<10	<1.0	<1.0	<1.0
	1/2/01	820	<0.50	<0.50	<0.50	<0.50	3.2	NA	NA	NA	NA
	8/13/04	400	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	11/8/04	330	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	1/19/05	280	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	4/20/05	460	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
MW-3	2/22/00	<50	<0.50	<0.50	<0.50	<0.50	4.5	NA	NA	NA	NA
	5/16/00	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0
	10/27/00	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0
	1/2/01	<50	<0.50	<0.50	<0.50	<0.50	<3.0	NA	NA	NA	NA
	8/13/04	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	11/8/04	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	1/19/05	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	4/20/05	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
MW-4	2/22/00	<50	<0.50	<0.50	<0.50	<0.50	5.3	NA	NA	NA	NA
	5/16/00	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0
	10/27/00	<50	<0.50	<0.50	<0.50	<0.50	<0.50	<10	<1.0	<1.0	<1.0
	1/2/01	<50	<0.50	<0.50	<0.50	<0.50	<3.0	NA	NA	NA	NA
	8/13/04	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	11/8/04	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	1/19/05	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0
	4/20/05	<50	<0.50	<0.50	<0.50	<0.50	<1.0	<10	<1.0	<1.0	<1.0

1. ug/L: micrograms per Liter
2. TPHG: Total Petroleum Hydrocarbons as Gasoline, analyzed in general accordance with EPA Method No. 8260B.
3. Benzene, Toluene, Ethylbenzene, and total Xylenes, analyzed in general accordance with EPA Method No. 8260B.
4. Fuel Oxygenates: MTBE (Methyl Tertiary-Butyl Ether), TBA (Tertiary-Butyl Alcohol), DIPE (Diisopropyl Ether), ETBE (Ethyl Tertiary-Butyl E and TAME (Tertiary-Amyl Methyl Ether), analyzed in general accordance with EPA Method No. 8260B.
5. <: denotes a value that is "less than" the laboratory method detection limit.
6. NA: Not Analyzed

Table B-3
Historic DO, DCO_2, and ORP Measurement Results
Branscomb Store, Branscomb, California

Sample Location	Date	DO[1] (ppm)[2]	DCO_2[3] (ppm)	ORP[4] (mV)[5]
MW-1	5/16/00	0.80	40	235
	10/27/00	0.57	60	135
	1/2/01	0.63	30	98
	8/13/04	0.56	80	56
	11/8/04	0.90	40	125
	1/19/05	1.21	50	83
	4/20/05	0.76	40	202
MW-2	5/16/00	0.49	50	-30
	10/27/00	0.50	70	-35
	1/2/01	0.58	70	82
	8/13/04	0.55	120	-102
	11/8/04	0.80	90	-20
	1/19/05	0.80	140	28
	4/20/05	0.63	120	-57
MW-3	5/16/00	0.58	20	140
	10/27/00	0.59	20	125
	1/2/01	1.68	30	83
	8/13/04	0.54	25	22
	11/8/04	1.43	30	109
	1/19/05	2.96	30	53
	4/20/05	2.07	30	218
MW-4	5/16/00	0.53	20	175
	10/27/00	0.56	20	110
	1/2/01	2.54	20	65
	8/13/04	0.59	20	53
	11/8/04	1.34	20	108
	1/19/05	3.39	30	89
	4/20/05	1.01	30	216

1. DO: Dissolved Oxygen, field measured using portable instrumentation.
2. ppm: parts per million.
3. DCO_2: Dissolved Carbon Dioxide, field measured using a field test kit.
4. ORP: Oxidation-Reduction Potential measured using portable instrumentation.
5. mV: millivolts

Appendix C

Laboratory Analytical Report

NORTH COAST
LABORATORIES LTD.

May 02, 2005

SHN Consulting Engineers and Geologists
812 West Wabash Avenue
Eureka, CA 95501

Attn: Frans Lowman

RE: 092057, Branscomb Store

Order No.: 0504459
Invoice No.: 49777
PO No.:
ELAP No. 1247-Expires July 2006

SAMPLE IDENTIFICATION

Fraction	Client Sample Description
01A	MW-4
02A	MW-3
03A	MW-1
04A	MW-2

ND = Not Detected at the Reporting Limit

Limit = Reporting Limit

All solid results are expressed on a wet-weight basis unless otherwise noted.

REPORT CERTIFIED BY

Laboratory Supervisor(s) | QA Unit | Jesse G. Chaney, Jr.
Laboratory Director

North Coast Laboratories, Ltd.

Date: *02-May-05*

CLIENT: SHN Consulting Engineers and Geologists
Project: 092057, Branscomb Store
Lab Order: 0504459

CASE NARRATIVE

Gasoline Components/Additives:
Sample MW-2 does not present a peak pattern consistent with that of gasoline. However, the reported result represents the amount of material in the gasoline range. The peaks elute towards the end of the gasoline range. In our judgement the material appears to be a product heavier than gasoline. Due to the differences in the purging efficiency of these heavier materials the results may be variable.

NORTH COAST LABORATORIES
5680 West End Road • Arcata, California 95521-9202 • 707-822-4649 • FAX 707-822-6831

Date: 02-May-05
WorkOrder: 0504459

ANALYTICAL REPORT

Client Sample ID: MW-4 **Received:** 4/20/05 **Collected:** 4/20/05 11:50
Lab ID: 0504459-01A

Test Name: Gasoline Components/Additives **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
Methyl tert-butyl ether (MTBE)	ND	1.0	µg/L	1.0		4/27/05
Tert-butyl alcohol (TBA)	ND	10	µg/L	1.0		4/27/05
Di-isopropyl ether (DIPE)	ND	1.0	µg/L	1.0		4/27/05
Ethyl tert-butyl ether (ETBE)	ND	1.0	µg/L	1.0		4/27/05
Benzene	ND	0.50	µg/L	1.0		4/27/05
Tert-amyl methyl ether (TAME)	ND	1.0	µg/L	1.0		4/27/05
Toluene	ND	0.50	µg/L	1.0		4/27/05
Ethylbenzene	ND	0.50	µg/L	1.0		4/27/05
m,p-Xylene	ND	0.50	µg/L	1.0		4/27/05
o-Xylene	ND	0.50	µg/L	1.0		4/27/05
Surrogate: 1,4-Dichlorobenzene-d4	83.5	80.8-139	% Rec	1.0		4/27/05

Test Name: TPH as Gasoline **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
TPHC Gasoline	ND	50	µg/L	1.0		4/27/05

Client Sample ID: MW-3 **Received:** 4/20/05 **Collected:** 4/20/05 12:20
Lab ID: 0504459-02A

Test Name: Gasoline Components/Additives **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
Methyl tert-butyl ether (MTBE)	ND	1.0	µg/L	1.0		4/27/05
Tert-butyl alcohol (TBA)	ND	10	µg/L	1.0		4/27/05
Di-isopropyl ether (DIPE)	ND	1.0	µg/L	1.0		4/27/05
Ethyl tert-butyl ether (ETBE)	ND	1.0	µg/L	1.0		4/27/05
Benzene	ND	0.50	µg/L	1.0		4/27/05
Tert-amyl methyl ether (TAME)	ND	1.0	µg/L	1.0		4/27/05
Toluene	ND	0.50	µg/L	1.0		4/27/05
Ethylbenzene	ND	0.50	µg/L	1.0		4/27/05
m,p-Xylene	ND	0.50	µg/L	1.0		4/27/05
o-Xylene	ND	0.50	µg/L	1.0		4/27/05
Surrogate: 1,4-Dichlorobenzene-d4	81.1	80.8-139	% Rec	1.0		4/27/05

Test Name: TPH as Gasoline **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
TPHC Gasoline	ND	50	µg/L	1.0		4/27/05

NORTH COAST LABORATORIES
5680 West End Road • Arcata, California 95521-9202 • 707-822-4649 • FAX 707-822-6831

Date: 02-May-05
WorkOrder: 0504459

ANALYTICAL REPORT

Client Sample ID: MW-1 **Received:** 4/20/05 **Collected:** 4/20/05 12:55
Lab ID: 0504459-03A

Test Name: Gasoline Components/Additives **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
Methyl tert-butyl ether (MTBE)	ND	1.0	µg/L	1.0		4/27/05
Tert-butyl alcohol (TBA)	ND	10	µg/L	1.0		4/27/05
Di-isopropyl ether (DIPE)	ND	1.0	µg/L	1.0		4/27/05
Ethyl tert-butyl ether (ETBE)	ND	1.0	µg/L	1.0		4/27/05
Benzene	ND	0.50	µg/L	1.0		4/27/05
Tert-amyl methyl ether (TAME)	ND	1.0	µg/L	1.0		4/27/05
Toluene	ND	0.50	µg/L	1.0		4/27/05
Ethylbenzene	ND	0.50	µg/L	1.0		4/27/05
m,p-Xylene	ND	0.50	µg/L	1.0		4/27/05
o-Xylene	ND	0.50	µg/L	1.0		4/27/05
Surrogate: 1,4-Dichlorobenzene-d4	85.6	80.8-139	% Rec	1.0		4/27/05

Test Name: TPH as Gasoline **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
TPHC Gasoline	ND	50	µg/L	1.0		4/27/05

Client Sample ID: MW-2 **Received:** 4/20/05 **Collected:** 4/20/05 13:10
Lab ID: 0504459-04A

Test Name: Gasoline Components/Additives **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
Methyl tert-butyl ether (MTBE)	ND	1.0	µg/L	1.0		4/27/05
Tert-butyl alcohol (TBA)	ND	10	µg/L	1.0		4/27/05
Di-isopropyl ether (DIPE)	ND	1.0	µg/L	1.0		4/27/05
Ethyl tert-butyl ether (ETBE)	ND	1.0	µg/L	1.0		4/27/05
Benzene	ND	0.50	µg/L	1.0		4/27/05
Tert-amyl methyl ether (TAME)	ND	1.0	µg/L	1.0		4/27/05
Toluene	ND	0.50	µg/L	1.0		4/27/05
Ethylbenzene	ND	0.50	µg/L	1.0		4/27/05
m,p-Xylene	ND	0.50	µg/L	1.0		4/27/05
o-Xylene	ND	0.50	µg/L	1.0		4/27/05
Surrogate: 1,4-Dichlorobenzene-d4	90.0	80.8-139	% Rec	1.0		4/27/05

Test Name: TPH as Gasoline **Reference:** LUFT/EPA 8260B Modified

Parameter	Result	Limit	Units	DF	Extracted	Analyzed
TPHC Gasoline	460	50	µg/L	1.0		4/27/05

NORTH COAST LABORATORIES
5680 West End Road • Arcata, California 95521-9202 • 707-822-4649 • FAX 707-822-6831

North Coast Laboratories, Ltd.

Date: 02-May-05

CLIENT: SHN Consulting Engineers and Geologists
Work Order: 0504459
Project: 092057, Branscomb Store

QC SUMMARY REPORT
Method Blank

Sample ID: **MB-4/27/05** Batch ID: **R34634** Test Code: **8260OXYW** Units: **µg/L** Analysis Date: **4/27/05 8:56:00 AM** Prep Date:
Client ID: Run ID: **ORGCMS2_050427B** SeqNo: **502097**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	ND	1.0									
Tert-butyl alcohol (TBA)	ND	10									
Di-isopropyl ether (DIPE)	ND	1.0									
Ethyl tert-butyl ether (ETBE)	ND	1.0									
Benzene	ND	0.50									
Tert-amyl methyl ether (TAME)	ND	1.0									
Toluene	0.1762	0.50									J
Ethylbenzene	0.1775	0.50									J
m,p-Xylene	0.2584	0.50									J
o-Xylene	0.2227	0.50									J
1,4-Dichlorobenzene-d4	0.821	0.10	1.00	0	82.1%	81	139	0			

Sample ID: **MB-4/27/05** Batch ID: **R34633** Test Code: **GASW-MS** Units: **µg/L** Analysis Date: **4/27/05 8:56:00 AM** Prep Date:
Client ID: Run ID: **ORGCMS2_050427A** SeqNo: **502077**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPHC Gasoline	18.66	50									J

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

North Coast Laboratories, Ltd.

Date: 02-May-05

CLIENT: SHN Consulting Engineers and Geologists
Work Order: 0504459
Project: 092057, Branscomb Store

QC SUMMARY REPORT
Laboratory Control Spike

Sample ID: **LCS-05289** Batch ID: **R34634** Test Code: **8260OXYW** Units: **µg/L** Analysis Date: **4/27/05 4:55:00 AM** Prep Date:
Client ID: Run ID: **ORGCMS2_050427B** SeqNo: **502094**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	18.72	1.0	20.0	0	93.6%	80	120	0			
Tert-butyl alcohol (TBA)	326.4	10	400	0	81.6%	25	162	0			
Di-isopropyl ether (DIPE)	18.69	1.0	20.0	0	93.5%	80	120	0			
Ethyl tert-butyl ether (ETBE)	18.19	1.0	20.0	0	91.0%	77	120	0			
Benzene	19.75	0.50	20.0	0	98.8%	78	117	0			
Tert-amyl methyl ether (TAME)	19.77	1.0	20.0	0	98.9%	64	136	0			
Toluene	18.38	0.50	20.0	0	91.9%	80	120	0			
Ethylbenzene	20.04	0.50	20.0	0	100%	80	120	0			
m,p-Xylene	42.25	0.50	40.0	0	106%	80	120	0			
o-Xylene	20.23	0.50	20.0	0	101%	80	120	0			
1,4-Dichlorobenzene-d4	1.08	0.10	1.00	0	108%	81	139	0			

Sample ID: **LCSD-05289** Batch ID: **R34634** Test Code: **8260OXYW** Units: **µg/L** Analysis Date: **4/27/05 5:25:00 AM** Prep Date:
Client ID: Run ID: **ORGCMS2_050427B** SeqNo: **502095**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Methyl tert-butyl ether (MTBE)	18.39	1.0	20.0	0	92.0%	80	120	18.7	1.77%	20	
Tert-butyl alcohol (TBA)	308.9	10	400	0	77.2%	25	162	326	5.48%	20	
Di-isopropyl ether (DIPE)	18.42	1.0	20.0	0	92.1%	80	120	18.7	1.48%	20	
Ethyl tert-butyl ether (ETBE)	17.93	1.0	20.0	0	89.7%	77	120	18.2	1.46%	20	
Benzene	19.74	0.50	20.0	0	98.7%	78	117	19.8	0.0821%	20	
Tert-amyl methyl ether (TAME)	19.47	1.0	20.0	0	97.4%	64	136	19.8	1.53%	20	
Toluene	18.51	0.50	20.0	0	92.5%	80	120	18.4	0.698%	20	
Ethylbenzene	19.77	0.50	20.0	0	98.9%	80	120	20.0	1.36%	20	
m,p-Xylene	41.48	0.50	40.0	0	104%	80	120	42.2	1.85%	20	
o-Xylene	20.31	0.50	20.0	0	102%	80	120	20.2	0.400%	20	
1,4-Dichlorobenzene-d4	1.11	0.10	1.00	0	111%	81	139	1.08	2.17%	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

CLIENT: SHN Consulting Engineers and Geologists
Work Order: 0504459
Project: 092057, Branscomb Store

QC SUMMARY REPORT
Laboratory Control Spike

Sample ID: **LCS-05290** Batch ID: **R34633** Test Code: **GASW-MS** Units: **µg/L** Analysis Date: **4/27/05 6:55:00 AM** Prep Date:
Client ID: Run ID: **ORGCMS2_050427A** SeqNo: **502074**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPHC Gasoline	1,061	50	1,000	0	106%	80	120	0			

Sample ID: **LCSD-05290** Batch ID: **R34633** Test Code: **GASW-MS** Units: **µg/L** Analysis Date: **4/27/05 7:25:00 AM** Prep Date:
Client ID: Run ID: **ORGCMS2_050427A** SeqNo: **502075**

Analyte	Result	Limit	SPK value	SPK Ref Val	% Rec	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
TPHC Gasoline	1,049	50	1,000	0	105%	80	120	1,060	1.13%	20	

Qualifiers:
ND - Not Detected at the Reporting Limit
J - Analyte detected below quantitation limits
S - Spike Recovery outside accepted recovery limits
R - RPD outside accepted recovery limits
B - Analyte detected in the associated Method Blank

NORTH COAST LABORATORIES LTD.
5680 West End Road • Arcata • CA 95521-9202
707-822-4649 Fax 707-822-6831

Chain of Custody

LABORATORY NUMBER: 0504459

Attention: Frans Lowman
Results & Invoice to: SHN
Address: 812 West Wabash Avenue
Eureka, CA 95501
Phone: 441-8855
Copies of Report to:
Sampler (Sign & Print): David R. Paine David R. Paine

TAT: ☐ 24 Hr ☐ 48 Hr ☐ 5 Day ☐ 5–7 Day
☒ STD (2–3 Wk) ☐ Other:
PRIOR AUTHORIZATION IS REQUIRED FOR RUSHES

REPORTING REQUIREMENTS: State Forms ☐
Preliminary: FAX ☐ Verbal ☐ By:__/__/__
Final Report: FAX ☐ Verbal ☐ By:__/__/__

PROJECT INFORMATION
Project Number: 092059
Project Name: Bronscomb Store
Purchase Order Number:

LAB ID	SAMPLE ID	DATE	TIME	MATRIX*	CONTAINER	PRESERVATIVE	ANALYSIS: 8260 list 1
	mw-4	4/20/05	1150	GW	9	b	X
	mw-3	"	1220	"	9	b	X
	mw-1	"	1255	"	9	b	X
	mw-2	"	1310	"	9	b	X

CONTAINER CODES: 1—½ gal. pl; 2—250 ml pl; 3—500 ml pl; 4—1 L Nalgene; 5—250 ml BG; 6—500 ml BG; 7—1 L BG; 8—1 L cg; 9—40 ml VOA; 10—125 ml VOA; 11—4 oz glass jar; 12—8 oz glass jar; 13—brass tube; 14—other

PRESERVATIVE CODES: a—HNO_3; b—HCl; c—H_2SO_4; d—$Na_2S_2O_3$; e—NaOH; f—$C_2H_3O_2Cl$; g—other

SAMPLE CONDITION/SPECIAL INSTRUCTIONS

EDF

Global ID# T0604591179

cooler temp = 8.1°C

RELINQUISHED BY (Sign & Print)	DATE/TIME	RECEIVED BY (Sign)	DATE/TIME
David R. Paine David R. Paine	4/20/05 1641	K. Thompson	4/20/05 1641

SAMPLE DISPOSAL
☒ NCL Disposal of Non-Contaminated
☐ Return ☐ Pickup

CHAIN OF CUSTODY SEALS Y/N/NA
SHIPPED VIA: UPS Air-Ex Fed-Ex Bus (Hand)

***MATRIX:** DW=Drinking Water; Eff=Effluent; Inf=Influent; SW=Surface Water; GW=Ground Water; S=Soil; O=Other.

ALL CONTAMINATED NON-AQUEOUS SAMPLES WILL BE RETURNED TO CLIENT

Appendix D

Intrinsic Bioremediation for Hydrocarbons

Appendix D

Intrinsic Bioremediation for Hydrocarbons

Intrinsic bioremediation is the degradation of a contaminant, such as petroleum hydrocarbons, by naturally occurring organisms. These organisms metabolize the contaminant as a primary carbon source. In addition to requiring a carbon source, an electron acceptor, such as oxygen, is required for organisms to metabolize the contaminant. The occurrence of intrinsic bioremediation can be demonstrated by measuring the loss of the contaminant concentration and electron acceptor, the increase in concentrations of metabolic by-products, and the change in concentrations of geochemical indicators. In some cases (ideally when the contaminant concentrations are low), natural degradation processes will reduce dissolved concentrations below the Maximum Contaminant Level (MCL) for drinking water standards, before reaching any nearby receptors. A detailed discussion for each indicator is presented below. Table 1 summarizes trends to look for when evaluating indicators of intrinsic bioremediation at a site.

Table D-1
Summa of Intrinsic Bioremediation Parameters

Groundwater Analytical Parameter	Contaminant Plume Related to Background	Downgradient Related to Contaminant Plume
Contaminant	Increases	Decreases
Dissolved Oxygen	Decreases	Increases
Dissolved Carbon Dioxide	Increases	Decreases
Reduction / Oxidation Potential	Decreases	Increases
Alkalinity	Increases	Decreases
Nitrate	Decreases	Increases
Manganese (II)	Increases	Decreases
Iron (II)	Increases	Decreases
Sulfate	Decreases	Increases
Dissolved Methane	Increases	Decreases

Dissolved Oxygen

Dissolved Oxygen (DO) is the favored electron acceptor for aerobic biodegradation of petroleum hydrocarbons (Buscheck, O'Reilly, 1995). Dissolved oxygen provides the most energy for microorganisms to metabolize petroleum hydrocarbons. However, the transfer of oxygen from the atmosphere to groundwater is slow and can cause oxygen depletion within the plume (Borden, Bedient, 1986), a decrease of DO concentrations within the plume is an indication that microorganisms are present. Threshold concentrations of DO for aerobic biodegradation range from 1 to 2 milligrams per Liter (mg/L) (McAllister, Chiang, 1994).

Dissolved Carbon Dioxide

Dissolved Carbon Dioxide (DCO_2) is produced as petroleum hydrocarbons are biologically metabolized. If DCO_2 concentrations are not removed by the natural carbonate buffering system (measured as alkalinity), the DCO_2 levels within the plume should be greater than background levels (Weidemeier et al., 1994).

Reduction-Oxidation Potential

The reduction-oxidation (redox) potential of groundwater is a measure of electron activity and is a measure of the relative tendency of a solute species to accept (gain) or transfer (lose) electrons. Oxidation is defined as "the loss of electrons while reduction is the gain of electrons" (Buscheck, O'Reilly, 1995).

Microorganisms catalyze nearly all the important redox reactions that occur in the groundwater. Microorganisms and their enzymes are involved in the redox process in order to acquire energy for the synthesis of new cells and maintenance of old cells (Freeze, Cherry, 1979). Therefore, redox reactions depend upon and influence rates of biodegradation. The redox potential for aerobic metabolism is greater than 50 millivolts (mV), while anaerobic metabolism has a redox potential less than 50 mV (US EPA, 1996 A). The redox potential inside the contaminant plume should be less than background levels. Table 2 lists preferred reactions by energy potential.

Table D-2
Preferred Reactions by Energy Potential

Electron Acceptor	Type of Reaction	Metabolic By-Product	Reaction Preference
Oxygen	Aerobic	CO_2	Most Preferred
Nitrate	Anaerobic	N_2, CO_2	ò
Manganese IV) (solid)	Anaerobic	Manganese II (soluble)	ò
Iron (III) (solid)	Anaerobic	Iron II (soluble)	ò
Sulfate	Anaerobic	H_2S	ò
Carbon Dioxide	Anaerobic	Methane	Least Preferred

pH

The pH is a logarithmic measure of the hydrogen ion activity. An optimal range for microorganisms is a pH range from 6-8 (Baker, Herson, 1994). The pH can be effected by biological activity when organic acids are produced as organisms metabolize contaminants. The pH can also effect the availability and mobility of nutrients and contaminants.

Alkalinity

Total alkalinity is a measure of water's capacity to absorb hydrogen ions without significant pH change. Alkalinity results from bicarbonates, carbonates and hydroxides (Viessman, Hammer, 1985). These species result from the dissolution of rock (such as carbonate rocks), the transfer of carbon dioxide into water, and respiration of microorganisms (Weidemeier et al., 1995). Alkalinity

is important because it buffers the groundwater system from organic acids produced from aerobic and anaerobic biodegradation processes. Alkalinity concentrations within the plume should be greater than background.

Nitrate

Once microorganisms have depleted concentrations of dissolved oxygen, an alternative electron acceptor may be utilized for anaerobic biodegradation. Depending upon the availability of nitrate (NO_3^-) in the groundwater, a process known as denitrification may occur. Microorganisms utilize nitrate as an electron acceptor and convert nitrate into nitrite (NO_2^-) and eventually into nitrogen gas (N_2) (Baker, Herson, 1994). Nitrate concentrations in the plume should be less than background.

Manganese (II)

When groundwater becomes depleted of dissolved oxygen and nitrate, conditions are sufficiently reducing for the reduction and dissolution of manganese coatings. These reactions result in reduced manganese in the groundwater (Carey et al. 1996). The use of manganese (IV) as a terminal electron acceptor by microorganisms yields a reduced water-soluble manganese (II).

Ferrous Iron

In some cases iron (III) or ferric iron is used as an electron acceptor in anaerobic biodegradation of petroleum hydrocarbons. Iron reduction is the conversion by microorganisms of iron (III) to ferrous iron or iron (II) (Buscheck, O'Reilly, 1995). The ferrous iron will be in a soluble form depending upon the Eh / pH conditions. Ferrous iron concentrations should be greater inside the plume than background. As soon as iron rich groundwater comes into contact with dissolved oxygen, the dissolved iron (II) will immediately oxidize to iron (III) and subsequently precipitate as iron coatings on soil sediments (Appelo and Postma, 1993).

Sulfate

Sulfate ($S0_4^{2-}$) is another alternative electron acceptor, once microorganisms have depleted oxygen. Sulfate reduction is the conversion of sulfate to hydrogen sulfide (H_2S). A reduction of sulfate concentrations across the plume is an indication that anaerobic biodegradation is occurring (Weidemeier et al., 1995).

Methane

Methane is produced only under strong reducing conditions by a group of strict anaerobes. Methanogens use CO_2 as a terminal electron acceptor and produce methane (ASTM, 1996). Table 2 shows that Methanogenic reactions are the least thermodynamically favored (USEPA, 1996 B).

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